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Huang

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(54) **ADAPTIVE TRANSITION OF USER EQUIPMENT**

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H04W 76/04 (2009.01)
H04W 76/06 (2009.01)

(52) **U.S. Cl.**
CPC ***H04W 72/0446*** (2013.01); ***H04W 76/045*** (2013.01); ***H04W 76/068*** (2013.01)

(58) **Field of Classification Search**
USPC 455/452.1, 450
See application file for complete search history.

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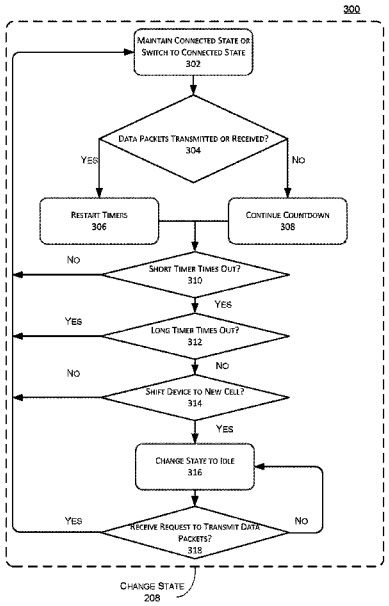
(57) **ABSTRACT**

In a wireless communication system, a base station application hosted on a base station may be configured to change, or switch, a wireless communication device located in the range of a respective cell between an idle state and a connected state.

24 Claims, 4 Drawing Sheets



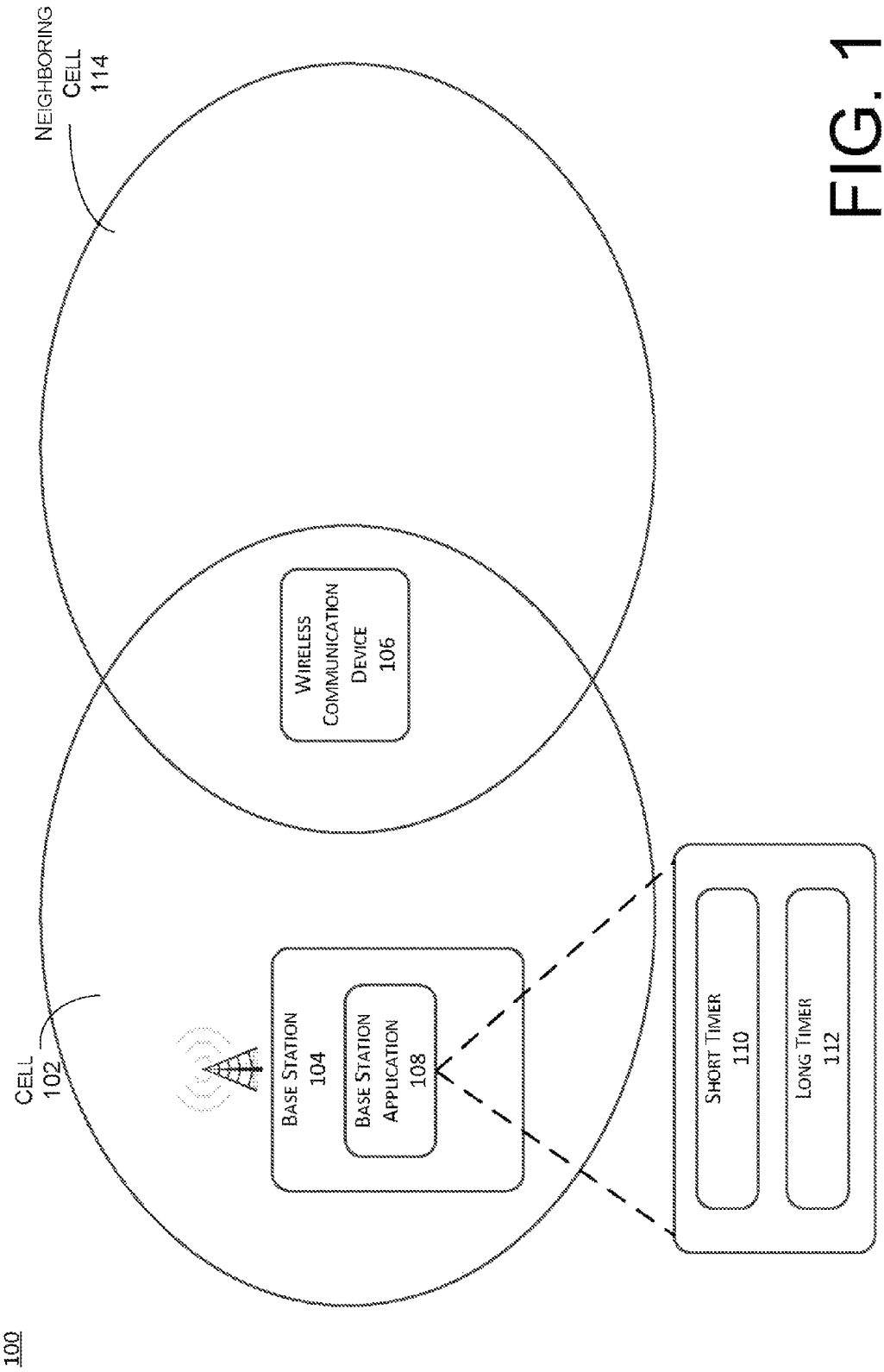

100
NEIGHBORING CELL 114
CELL 102
WIRELESS COMMUNICATION DEVICE 106
BASE STATION 104
BASE STATION APPLICATION 108
SHORT TIMER 110
LONG TIMER 112

FIG. 1

200

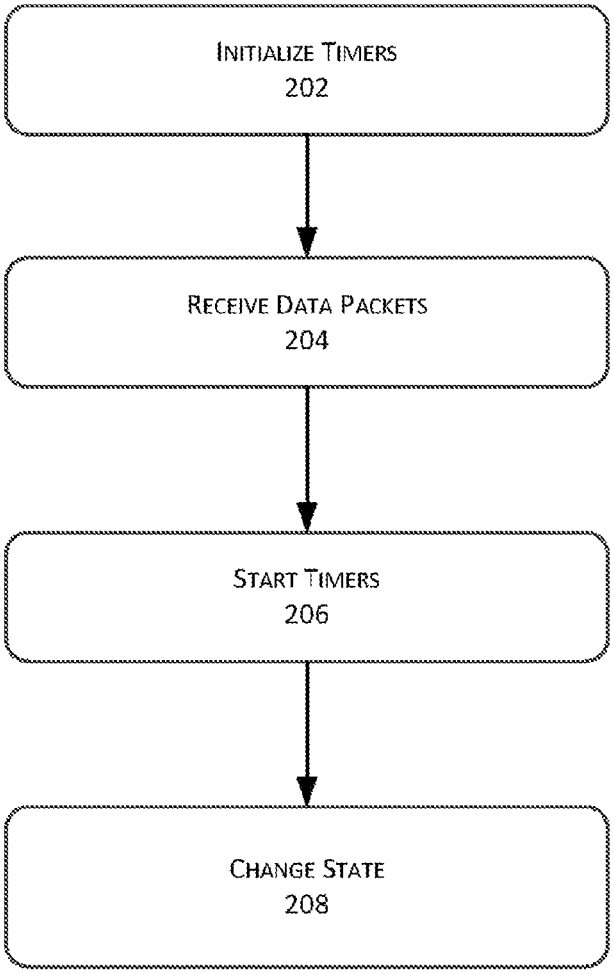

INITIALIZE TIMERS
202
RECEIVE DATA PACKETS
204
START TIMERS
206
CHANGE STATE
208

FIG. 2

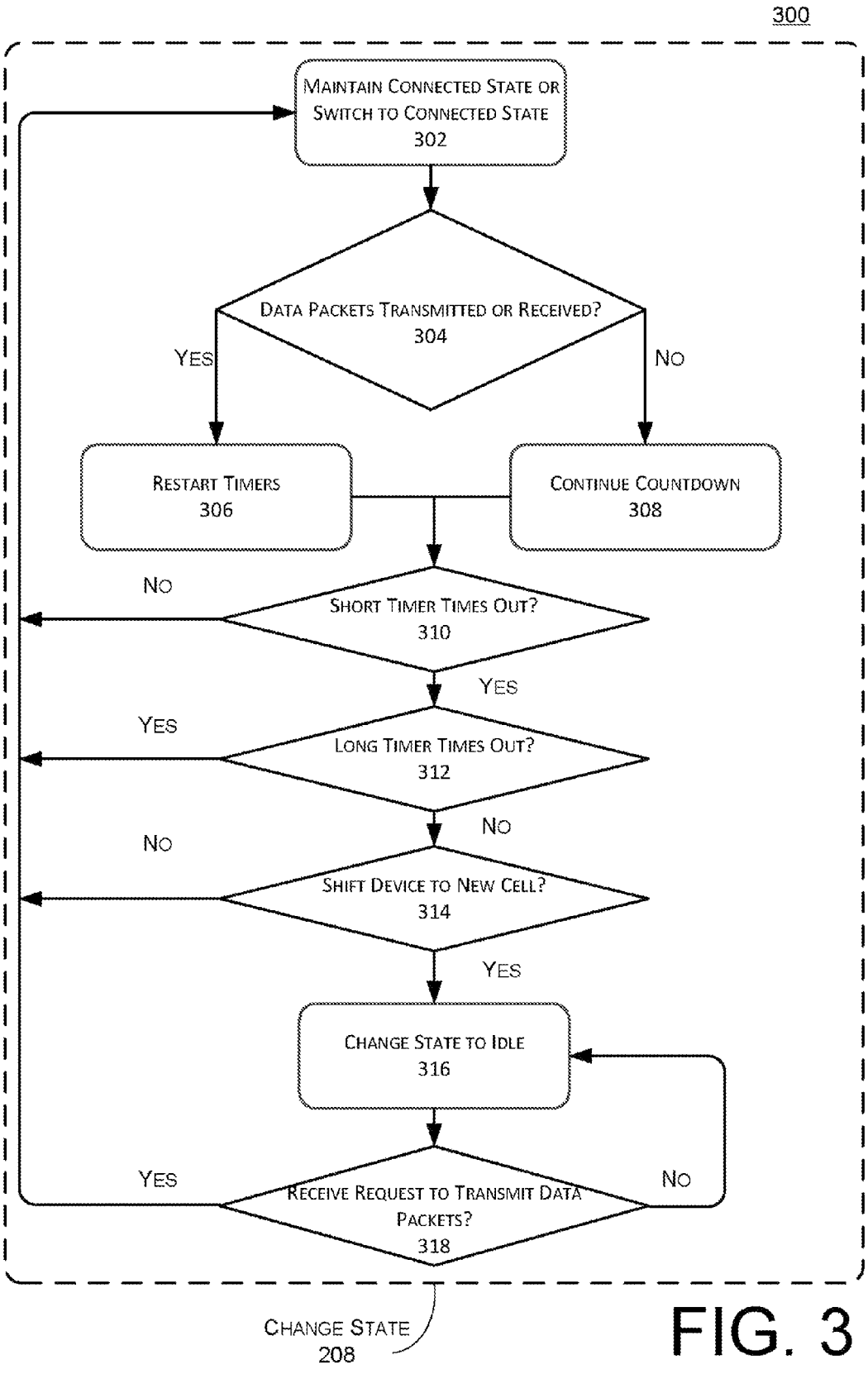

300
MAINTAIN CONNECTED STATE OR SWITCH TO CONNECTED STATE 302
DATA PACKETS TRANSMITTED OR RECEIVED? 304
YES
NO
RESTART TIMERS 306
CONTINUE COUNTDOWN 308
NO
SHORT TIMER TIMES OUT? 310
YES
YES
LONG TIMER TIMES OUT? 312
NO
NO
SHIFT DEVICE TO NEW CELL? 314
YES
CHANGE STATE TO IDLE 316
YES
RECEIVE REQUEST TO TRANSMIT DATA PACKETS? 318
NO
CHANGE STATE 208

FIG. 3

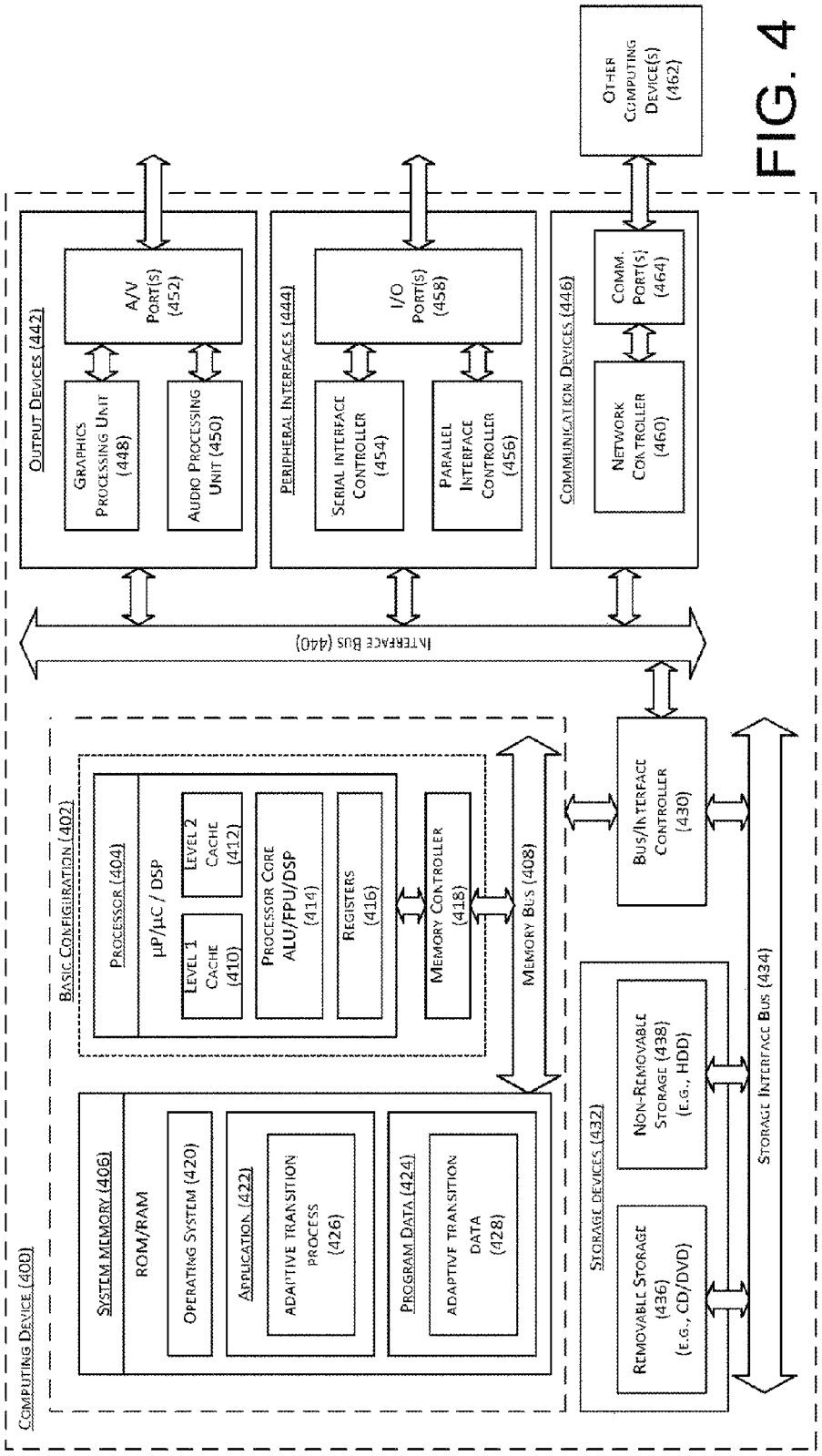

COMPUTING DEVICE (400)
BASIC CONFIGURATION (402)
PROCESSOR (404)
μP/μC / DSP
LEVEL 1 CACHE (410)
LEVEL 2 CACHE (412)
PROCESSOR CORE ALU/FPU/DSP (414)
REGISTERS (416)
MEMORY CONTROLLER (418)
SYSTEM MEMORY (406)
ROM/RAM
OPERATING SYSTEM (420)
APPLICATION (422)
ADAPTIVE TRANSITION PROCESS (426)
PROGRAM DATA (424)
ADAPTIVE TRANSITION DATA (428)
MEMORY BUS (408)
BUS/INTERFACE CONTROLLER (430)
STORAGE DEVICES (432)
REMOVABLE STORAGE (436) (E.G., CD/DVD)
NON-REMOVABLE STORAGE (438) (E.G., HDD)
STORAGE INTERFACE BUS (434)
INTERFACE BUS (440)
OUTPUT DEVICES (442)
GRAPHICS PROCESSING UNIT (448)
AUDIO PROCESSING UNIT (450)
A/V PORT(S) (452)
PERIPHERAL INTERFACES (444)
SERIAL INTERFACE CONTROLLER (454)
PARALLEL INTERFACE CONTROLLER (456)
I/O PORT(S) (458)
COMMUNICATION DEVICES (446)
NETWORK CONTROLLER (460)
COMM. PORT(S) (464)
OTHER COMPUTING DEVICE(S) (462)

FIG. 4

ADAPTIVE TRANSITION OF USER EQUIPMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

This Application is the National Stage filing under 35 U.S.C. §371 of PCT Application Ser. No. PCT/CN13/76900 filed on Jun. 7, 2013. The disclosure of the PCT Application is hereby incorporated herein by reference in its entirety.

TECHNICAL FIELD

The technologies described herein pertain generally to adaptive transition of user equipment that may be communicatively coupled to a base station within a cell of a cellular network.

BACKGROUND

Unless otherwise indicated herein, the approaches described in this section are not prior art to the claims in this application and are not admitted to be prior art by inclusion in this section.

In a wireless communication system, e.g., a cell of a cellular network, a base station may be configured to change, or switch, the communication state of a user equipment between a connected state and an idle state. However, the change process may cost great transmissions and interactions between the user equipment and the cell and, thus, cause waste of communication resources.

SUMMARY

Technologies are generally described for adaptive transition of user equipment. The various techniques may be implemented in various systems, methods, and/or computer-readable mediums.

In some examples, various techniques may be implemented as methods. Some methods may include initializing a first timer and a second timer with respect to a wireless communication device that is in a connected state, wherein the first timer times out after a first duration of time, the second timer times out after a second duration of time, and the second duration of time is longer than the first duration of time; receiving one or more data packets from the wireless communication device; starting the first timer and the second timer simultaneously; and changing a state of the wireless communication device from the connected state to an idle state when a signal strength between the wireless communication device and a base station is less than a predefined signal strength threshold.

Some other methods may include simultaneously starting a first timer and a second timer with respect to a wireless communication device, wherein the first timer times out after a first duration of time, the second timer times out after a second duration of time, and the second duration of time is longer than the first duration of time; receiving one or more data packets associated with the wireless communication device; determining that the wireless communication device is in a first type of communication state when the receiving occurs before the first timer times out; and determining that the wireless communication device is in a second type of communication state different from the first type of communication state when the receiving occurs after the first timer times out.

In some other examples, various techniques may be implemented as executable instructions stored on one or more computer-readable mediums that, when executed, cause one or more processors to execute various operations. Some computer-readable mediums may store executable instructions that may cause the one or more processors to executing operations including simultaneously starting a first timer and a second timer with respect to a wireless communication device that is in a connected state, wherein the first timer times out after a first duration of time, the second timer times out after a second duration of time, and the second duration of time is longer than the first duration of time; changing a state of the wireless communication device from the connected state to an idle state when a signal strength between the wireless communication device and a base station is less than a predefined signal strength threshold.

The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

In the detailed description that follows, embodiments are described as illustrations only since various changes and modifications will become apparent to those skilled in the art from the following detailed description. The use of the same reference numbers in different figures indicates similar or identical items. In the drawings:

FIG. **1** shows an example system in which adaptive transition of user equipment may be implemented, arranged in accordance with at least some embodiments described herein;

FIG. **2** shows an example configuration of a processing flow of operations by which adaptive transition of user equipment may be implemented, arranged in accordance with at least some embodiments described herein;

FIG. **3** shows an example configuration of a sub-processing flow of operations by which adaptive transition of user equipment may be implemented, arranged in accordance with at least some embodiments described herein; and

FIG. **4** shows a block diagram illustrating an example computing device that is arranged for adaptive transition of user equipment, arranged in accordance with at least some embodiments described herein.

DETAILED DESCRIPTION

In the following detailed description, references are made to the accompanying drawings, which form a part of the description. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. Furthermore, unless otherwise noted, the description of each successive drawing may reference features from one or more of the previous drawings to provide clearer context and a more substantive explanation of the current embodiment. Still, the embodiments described in the detailed description, drawings, and claims are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented herein. It will be readily understood that the aspects of the present disclosure, as generally described herein and illustrated in the drawings, may be arranged, substituted, combined, separated, and designed in a wide variety of different configurations, all of which are explicitly contemplated herein.

FIG. **1** shows an example system **100** in which adaptive transition of user equipment may be implemented, arranged in accordance with at least some embodiments described herein. As depicted, example system **100** may include, at least, a cell **102**; a base station **104** that provides communication services for wireless communication devices within cell **102**; wireless communication device **106** that is located within cell **102**; application **108** that is hosted by base station **104**; and a short timer **110** and a long timer **112**, which are implemented by application **108**. Wireless communication device **106** may be located in an overlapped coverage of cell **102** and a neighboring cell **114**.

Cell **102** may refer to a range of radio coverage in a respective cellular network. Cell **102** may be configured to provide wireless communication for user equipment therein, e.g., wireless communication device **106**, and may further be equipped with base station **104**. The range may be measured in terms of distance from an antenna corresponding to base station **104**, by which the distance in a given direction may depend upon a variety of performance parameters, e.g., electric current powering the antenna, antenna height, topography in a given direction, etc. Cell **102** may be overlapped with neighboring cell **114**.

Base station **104** may refer to a combination of physical devices and hardware components that may be configured to host one or more software programs, e.g., base station application **108**, to support wireless communication between one or more embodiments of wireless communication device **106** within cell **102**. That is, base station **104** may be configured to transmit wireless signals to and receive wireless signals from the one or more embodiments of wireless communication device **106** within cell **102**. Such communication may be implemented in accordance with different wireless communication standards including Time Division Duplex Long Term Evolution (TDD-LTE), Frequency Division Duplexing (FDD-LTE), IEEE 802.15.4, Global System for Mobile Communications (GSM), General packet radio service (GPRS), Code Division Multiple Access (CDMA), 3rd generation of mobile telecommunications technology (3G), etc., which may further determine a work mode of the respective embodiments of wireless communication device **106** within cell **102**. The work modes may include TDD mode and FDD mode. Such examples are not intended to be limiting, and therefore should not be interpreted to be so.

Wireless communication device **106** may refer to a mobile (or portable) electronic device such as a mobile phone, smartphone, personal digital assistant (PDA) a personal media player device, an application specific device, or a hybrid device that includes any of the above functions. Alternatively, wireless communication device **106** may be implemented as a personal computer including tablet, laptop computer, non-laptop computer configure configurations, etc. In an LTE system, wireless communication device **106** may be set in an idle state or a connected state by base station application **108**.

As referenced herein, "an idle state" may refer to a state in which wireless communication device **106** may not transmit and to receive one or more data packets from base station **104**.

As referenced herein, "a connected state" may refer wireless communication device **106** may be permitted to transmit and to receive one or more data packets from base station **104**. The connected state may include a Radio Resource Control (RRC) Connected state in accordance with LTE standard.

Base station application **108** may refer to a software program hosted or otherwise executed on base station **104** that may be configured to control physical devices and hardware components of base station **104**. In accordance with some examples, base station application **108** may be configured to change, or switch, the state of wireless communication device **106** between the idle state and the connected state according to short timer **110** and long timer **112**.

Short timer **110** and long timer **112** may each refer to a software program, a hardware component, a firmware, or a combination thereof that may be configured to count down from a time duration predetermined by base station application **108**. In accordance with an example execution of base station application **108**, duration of time set for long timer **112** may be longer than the duration of time set for short timer **110**.

In accordance with some examples, base station application **108** may be configured to initiate and start short timer **110** and long timer **112** when wireless communication device **106** completes transmission of a data packet, i.e., when wireless communication device **106** is in the connected state. Further, base station application **108** may be configured to restart short timer **110** and long timer **112** when wireless communication device **106** requests to transmit one or more data packets or when other embodiments of wireless communication device **106** transmits one or more requests to, e.g., base station **104**, to transmit one or more data packets to wireless communication device **106**. As depicted in FIG. **1**, wireless communication device **106** may be located in an area in which cell **102** and neighboring cell **114** overlap. Thus, when the strength of the wireless signals transmitted from base station **104** to wireless communication device **106** falls below a predetermined threshold level or when the strength of the wireless signals transmitted from base station **104** to wireless communication device **106** is lower than the signal strength from neighboring base station **104** by a predefined offset wireless communication device **106** may submit a request to base station **104** to start communication with other wireless communication devices via neighboring cell **114**. An example of such request may include Event A3, in accordance with an LTE system. Base station application **108** may change wireless communication device **106** to the idle state and to stop short timer **110** and long timer **112** if base station **104** receives the request before long timer **112** times out. On the contrary, base station application **108** may be configured to maintain short timer **110**, long timer **112**, and the connected state of wireless communication device **106** to avoid additional waste of wireless communication resources if base station **104** receives the request after long timer **112** times out.

Thus, FIG. **1** shows an example system **100** that may include cell **102** supported by base station **104** that hosts base station application **108**, which may include short timer **110** and long timer **112**.

FIG. **2** shows an example configuration of a processing flow **200** of operations by which adaptive transition of user equipment may be implemented, arranged in accordance with at least some embodiments described herein. As depicted, processing flow **200** may include sub-processes executed by various components that are part of example system **100**. However, processing flow **200** is not limited to such components, and modification may be made by re-ordering two or more of the sub-processes described here, eliminating at least one of the sub-processes, adding further sub-processes, substituting components, or even having various components assuming sub-processing roles accorded to other components in the following description. Processing flow **200** may include various operations, functions, or actions as illustrated by one or more of blocks **202**, **204**, **206**, and **208**. Processing may begin at block **202**.

Block **202** (Initialize Timers) may refer to base station application **108** initializing a first timer, e.g., short timer **110**, and a second timer, e.g., long timer **112**, with respect to

wireless communication device **106** that is in a connected state, relative to base station **104**. The connected state may include a Radio Resource Control (RRC) Connected state in accordance with LTE standard. The time duration initialized for long timer **112** may be longer than the time duration of short timer **110**. In accordance with some examples, the time duration of short timer **110** may be set to be greater than a predefined interval of delay between two consecutive data packets, e.g., Packet Delay Budget (PDB) in accordance with standardized Quality of Service (QoS) Class Identifier. In some other examples, the interval of delay between two consecutive data packets may be predefined based on statistical data, e.g., average delay between data packets during transmission. Processing may continue from block **202** to block **204**.

Block **204** (Receive Data Packets) may refer to base station **104** receiving one or more data packets transmitted by wireless communication device **106**. Wireless communication device **106** may be in a connected state to transmit or receive data packets, relative to base station **104**. When wireless communication device **106** is in an idle state, base station application **108** may change the state of wireless communication device **106** to the connected state before base station **104** transmits data packets to wireless communication device **106**. Processing may continue from block **204** to block **206**.

Block **206** (Start Timers) may refer to base station application **108** simultaneously starting short timer **110** and long timer **112** upon the one or more data packets being received at base station **104**. Short timer **110** and long timer **112** may be configured to count down from the respective initialized durations of time. Processing may continue from block **206** to block **208**.

Block **208** (Change state) may refer to base station application **108** changing the state of wireless communication device **106** to an idle state when a signal strength between the wireless communication device and base station **104** is less than a predefined signal strength threshold. In accordance with some examples, wireless communication device **106** may be configured to monitor the signal strength of the wireless signals transmitted from base station **104** by monitoring the electricity current through an antenna of wireless communication device **106**. When the signal strength falls below the predefined signal strength threshold, base station **104** may receive a message indicative of the poor signal strength from wireless communication device **106**. The indication may include a report from wireless communication device **106**, which indicates that a signal strength of neighboring cell **114** is stronger than the monitored signal strength in cell **102**.

Thus, FIG. **2** shows an example configuration of a processing flow **200** of operations that may include initializing short timer **110** and long timer **112** with respect to wireless communication device **106**, receiving one or more data packets from wireless communication device **106**, starting short timer and long timer simultaneously in response to the receiving, and changing a state of wireless communication device **106** from the connected state to an idle state when a signal strength between wireless communication device **106** and base station **104** is less than a predefined signal strength threshold.

FIG. **3** shows an example configuration of a sub-processing flow **300** of operations by which adaptive transition of user equipment may be implemented, arranged in accordance with at least some embodiments described herein. As depicted, sub-processing flow **300** may include sub-processes executed by various components that are part of example system **100**. However, sub-processing flow **300** is not limited to such components, and modification may be made by re-ordering two or more of the sub-processes described here, eliminating at least one of the sub-processes, adding further sub-processes, substituting components, or even having various components assuming sub-processing roles accorded to other components in the following description. Sub-processing flow **300** may include various operations, functions, or actions as illustrated by one or more of blocks **302**, **304**, **306**, **308**, **310**, **312**, **314**, **316**, and **318**. Processing may begin at block **302**.

Block **302** (Maintain Connected State or Switch to Connected State) may refer to base station application **108** maintaining the state of wireless communication device **106** as connected or switch the state of wireless communication device **106** from idle state to connected state. Processing may continue from block **302** to block **304**.

Decision block **304** (Data Packets Transmitted or Received?) may refer to base station application **108** determining whether wireless communication device **106** is transmitting or receiving one or more data packets after short timer **110** and long timer **112** are started by base station application **108**. If "yes," processing may continue from decision block **304** to block **306**. If "no," processing may continue from decision block **304** to block **308**.

Block **306** (Restart Timers) may refer to base station application **108** restarting short timer **110** and long timer **112** simultaneously when wireless communication device **106** has been determined to be transmitting or receiving one or more data packets after short timer **110** and long timer **112** were started. Processing may continue from block **306** to decision block **310**.

Block **308** (Continue Countdown) may refer to base station application **108** continuing the countdowns by short timer **110** and long timer **112**, respectively, if wireless communication device **106** has not been determined to be transmitting or receiving one or more data packets after short timer **110** and long timer **112** were started. Processing may continue from block **308** to decision block **310**.

Decision block **310** (Short Timer Times Out?) may refer to base station application **108** determining whether short timer **110** times out prior to base station application **108** receiving a request to transmit data packets from wireless communication device **106**. If "yes," processing may continue from decision block **310** to decision block **312**. If "no," processing may revert from decision block **310** to block **302**.

Decision block **312** (Long Timer Times Out?) may refer to base station application **108** determining whether long timer **112** times out prior to base station application **108** receiving the request to start communication with other wireless communication devices via neighboring cell **114**. If "no," processing may continue from decision block **312** to decision block **314**. If "yes," processing may revert from decision block **310** to block **302**.

Decision block **314** (Shift Device to New Cell?) may refer to base station application **108** determining whether base station **104** has received, from wireless communication device **106**, an indication or notification that wireless communication device **106** will start wireless communication via a base station corresponding to neighboring cell **114**, instead of base station **104** corresponding to cell **102**. In some examples, when wireless communication device **106** is located in an area in which cell **102** and neighboring cell **114** overlap, the wireless signal strength of the wireless signals transmitted from base station **104** to wireless communication device **106** may fall below a predetermined threshold level, resulting in deteriorated communication quality. In order to avoid the deteriorated communication quality due to the weak wireless signals transmitted from base station **104**, wireless communication device **106** may then start to communicate

with other wireless communication devices via neighboring cell **114** and simultaneously notify base station **104** of the new communication via neighboring cell **114**. If "yes," processing may continue from decision block **314** to block **316**. If "no," processing may revert to from decision block **314** to block **302**.

Block **316** (Change State to Idle) may refer to base station application **108** changing the state of wireless communication device **106** to an idle state. Alternatively, base station application **108** may be configured to maintain the state of wireless communication device **106** as an idle state. When wireless communication device **106** is set in an idle state, base station **104** may not receive or transmit data packets from or to wireless communication device **106** unless wireless communication **106** submits a request to base station **104** and base station application **108** changes the state to a connected state. Processing may continue from block **316** to decision block **318**.

Decision block **318** (Receive Request to Transmit Data Packets?) may refer to base station application **108** determining whether base station **104** has received one or more requests, submitted by wireless communication device **106**, to transmit one or more data packets from wireless communication device **106**. If "yes," processing may revert to block **302**. If "no," processing may revert to block **316**.

Thus, FIG. **3** shows an example configuration of a sub-processing flow **300** of operations that may be included in block **208** of processing flow **200**.

FIG. **4** is a block diagram illustrating an example computing device **400** that is arranged for adaptive transition of user equipment in accordance with the present disclosure. In a very basic configuration **402**, computing device **400** typically includes one or more processors **404** and a system memory **406**. A memory bus **408** may be used for communicating between processor **404** and system memory **406**.

Depending on the desired configuration, processor **404** may be of any type including but not limited to a microprocessor (μP), a microcontroller (μC), a digital signal processor (DSP), or any combination thereof. Processor **404** may include one more levels of caching, such as a level one cache **410** and a level two cache **412**, a processor core **414**, and registers **416**. An example processor core **414** may include an arithmetic logic unit (ALU), a floating point unit (FPU), a digital signal processing core (DSP Core), or any combination thereof. An example memory controller **418** may also be used with processor **404**, or in some implementations memory controller **418** may be an internal part of processor **404**.

Depending on the desired configuration, system memory **406** may be of any type including but not limited to volatile memory (such as RAM), non-volatile memory (such as ROM, flash memory, etc.) or any combination thereof. System memory **406** may include an operating system **420**, one or more applications **422**, and program data **424**. Application **422** may include an adaptive transition process **426** that is arranged to perform the functions as described herein including those described with respect to process **200** of FIG. **2** and process **300** of FIG. **3**. Program data **424** may include adaptive transition data **428** that may be useful for adaptive transition process **426** as is described herein. In some embodiments, application **422** may be arranged to operate with program data **424** on operating system **420** such that implementations of robust adaptive transition of user equipment may be provided as described herein. This described basic configuration **402** is illustrated in FIG. **4** by those components within the inner dashed line.

Computing device **400** may have additional features or functionality, and additional interfaces to facilitate communications between basic configuration **402** and any required devices and interfaces. For example, a bus/interface controller **430** may be used to facilitate communications between basic configuration **402** and one or more data storage devices **432** via a storage interface bus **434**. Data storage devices **432** may be removable storage devices **436**, non-removable storage devices **438**, or a combination thereof. Examples of removable storage and non-removable storage devices include magnetic disk devices such as flexible disk drives and hard-disk drives (HDD), optical disk drives such as compact disk (CD) drives or digital versatile disk (DVD) drives, solid state drives (SSD), and tape drives to name a few. Example computer storage media may include volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information, such as computer readable instructions, data structures, program modules, or other data.

System memory **406**, removable storage devices **436** and non-removable storage devices **438** are examples of computer storage media. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which may be used to store the desired information and which may be accessed by computing device **400**. Any such computer storage media may be part of computing device **400**.

Computing device **400** may also include an interface bus **440** for facilitating communication from various interface devices (e.g., output devices **442**, peripheral interfaces **444**, and communication devices **446**) to basic configuration **402** via bus/interface controller **430**. Example output devices **442** include a graphics processing unit **448** and an audio processing unit **450**, which may be configured to communicate to various external devices such as a display or speakers via one or more A/V ports **452**. Example peripheral interfaces **444** include a serial interface controller **454** or a parallel interface controller **456**, which may be configured to communicate with external devices such as input devices (e.g., keyboard, mouse, pen, voice input device, touch input device, etc.) or other peripheral devices (e.g., printer, scanner, etc.) via one or more I/O ports **458**. An example communication device **446** includes a network controller **460**, which may be arranged to facilitate communications with one or more other computing devices **462** over a network communication link via one or more communication ports **464**.

The network communication link may be one example of a communication media. Communication media may typically be embodied by computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave or other transport mechanism, and may include any information delivery media. A "modulated data signal" may be a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media may include wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, radio frequency (RF), microwave, infrared (IR) and other wireless media. The term computer readable media as used herein may include both storage media and communication media.

Computing device **400** may be implemented as a portion of a small-form factor portable (or mobile) electronic device such as a cell phone, a personal data assistant (PDA), a per-

sonal media player device, a wireless web-watch device, a personal headset device, an application specific device, or a hybrid device that include any of the above functions. Computing device **400** may also be implemented as a personal computer including both laptop computer and non-laptop computer configurations.

I claim:

1. A method, comprising:

initializing a first timer and a second timer with respect to a wireless communication device that is in a connected state, wherein:

the first timer times out after a first duration of time,

the second timer times out after a second duration of time, and

the second duration of time is longer than the first duration of time;

receiving one or more data packets from the wireless communication device;

starting the first timer and the second timer simultaneously; and

changing a state of the wireless communication device from the connected state to an idle state when a signal strength between the wireless communication device and a base station becomes less than a predefined signal strength threshold when the first timer times out and the second timer has not timed out.

2. The method of claim **1**, wherein the connected state is a Radio Resource Control (RRC)-Connected state in accordance with the Long Term Evolution (LTE) standard.

3. The method of claim **1**, wherein the first duration of time is greater than a predefined interval of delay between consecutive data packets.

4. The method of claim **1**, further comprising:

receiving an indication that the signal strength between the wireless communication device and the base station is less than the predefined signal strength threshold.

5. The method of claim **4**, wherein the receiving an indication comprises receiving a report from the wireless communication device indicating that a signal strength of a neighboring cell is stronger than a signal strength of a serving cell that the wireless communication device is in by a predefined offset.

6. The method of claim **1**, further comprising:

terminating the first timer and the second timer when changing the state of the wireless communication device to the idle state.

7. The method of claim **1**, further comprising:

receiving one or more additional data packets from the wireless communication device; and

reverting the state of the wireless communication device to the connected state in response to the receiving the one or more additional data packets from the wireless communication device.

8. The method of claim **1**, further comprising:

maintaining the state of the wireless communication device in the connected state when:

no data packets have been received from the wireless communication device before the second timer times out, and

the signal strength between the wireless communication device and the base station is greater than or equal to the predefined signal strength threshold.

9. A method, comprising:

simultaneously starting a first timer and a second timer with respect to a wireless communication device when the wireless communication device receives or transmits a first data packet in a first type of communication state, wherein:

the first timer times out after a first duration of time,

the second timer times out after a second duration of time from the starting, and

the second duration of time is longer than the first duration of time;

receiving one or more second data packets associated with the wireless communication device;

maintaining the wireless communication device in the first type of communication state when the receiving occurs before the first timer times out; and

changing the wireless communication device to a second type of communication state different from the first type of communication state in response to an event that indicates the wireless communication device is switching between two cells after the first timer times out.

10. The method of claim **9**, wherein the first duration of time is greater than a predefined interval of delay between consecutive second data packets.

11. The method of claim **9**, wherein the wireless communication device receives or transmits data packets other than background information when in the first type of communication state, and wherein the wireless communication device transmits background information and no data packets when in the second type of communication state.

12. The method of claim **9**, wherein the changing comprises receiving an indication that a signal strength between the wireless communication device and a base station is less than a predefined signal strength threshold.

13. The method of claim **12**, wherein the receiving an indication comprises receiving a report from the wireless communication device indicating that a signal strength of a neighboring cell is better than a signal strength of a serving cell that the wireless communication device is in by a predefined offset.

14. The method of claim **12**, further comprising:

setting a state of the wireless communication device to an idle state in response to:

the first timer having timed out,

the second timer having not timed out, and

the receiving of the indication.

15. The method of claim **14**, further comprising:

terminating the first timer and the second timer.

16. The method of claim **14**, further comprising:

setting the state of the wireless communication device to a connected state when receiving one or more additional data packets from the wireless communication device.

17. A non-transitory computer-readable medium storing instructions that, when executed, cause one or more processors to perform operations comprising:

simultaneously starting a first timer and a second timer with respect to a wireless communication device that is in a connected state, wherein:

the first timer times out after a first duration of time,

the second timer times out after a second duration of time, and

the second duration of time is longer than the first duration of time; and

changing a state of the wireless communication device from the connected state to an idle state when:

no data packets have been received from the wireless communication device after the first timer times out and before the second timer times out, and

a signal strength between the wireless communication device and a base station is less than a predefined signal strength threshold.

18. The computer-readable medium of claim **17**, wherein the connected state is a Radio Resource Control (RRC)-Connected state in accordance with the Long Term Evolution (LTE) standard.

19. The computer-readable medium of claim **17**, wherein the first duration of time is greater than a predefined interval of delay between consecutive data packets.

20. The computer-readable medium of claim **17**, wherein the operations further comprise:

receiving an indication that the signal strength between the wireless communication device and the base station is less than the predefined signal strength threshold.

21. The computer-readable medium of claim **20**, wherein the receiving and indication comprises receiving an Event A3 report from the wireless communication device in accordance with the LTE standard.

22. The computer-readable medium of claim **17**, wherein the operations further comprise:

terminating the first timer and the second timer when changing the state of the wireless communication device to the idle state.

23. The computer-readable medium of claim **17**, wherein the operations further comprise:

receiving one or more additional data packets from the wireless communication device; and

reverting the state of the wireless communication device to the connected state in response to the receiving the one or more additional data packets from the wireless communication device.

24. The computer-readable medium of claim **17**, wherein the operations further comprise:

maintaining the state of the wireless communication device in the connected state when:

no data packets have been received from the wireless communication device before the second timer times out, and

the signal strength between the wireless communication device and the base station is greater than or equal to the predefined signal strength threshold.

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